

# **The Effects of Michigan's School Readiness Program on Young Children's Abilities at Kindergarten Entry**

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### **Executive Summary**

This study measures the effects of Michigan's School Readiness Program (MSRP) on entering kindergartners' academic skills using an innovative research model. Language (receptive vocabulary), early literacy and early math skills were assessed in a sample of 865 children from across Michigan. We find that Michigan's School Readiness Program has statistically significant and meaningful impacts on children's early literacy and mathematical development.

Specifically:

1. MSRP produces an increase in children's vocabulary scores of over 3 raw score points, 24 percent more growth over the year due to the program (and a 6 percent increase over children's average vocabulary scores). This improvement translates into an additional two months of progress in vocabulary growth due to the program. This outcome is particularly important because the measure is strongly predictive of general cognitive abilities.
2. Children who attended MSRP scored higher on a test of early math skills. MSRP increased children's math scores by over 2 raw score points, 64 percent more growth over the year due to the program (and a 21 percent increase over children's average math scores). Skills tested include basic number concepts, simple addition and subtraction, telling time and counting money.
3. MSRP has large effects on children's understanding of print concepts. The program increased children's print awareness scores by over 22 percentage points, more than doubling growth over the year due to the program (and a 63 percent increase in children's average print awareness scores). Children who attended MSRP before entering kindergarten knew more letters, more letter-sound associations and were more familiar with words and book concepts.
4. We found no significant effects on a measure of children's skills in phonological awareness. As this measure is relatively new, it is difficult to determine the extent to which the result is due to a true lack of program effects.

Michigan's MSRP evaluation is part of a larger multi-state study of the effects of state-funded preschool, which includes 5071 preschool and kindergarten children sampled across four additional states – New Jersey, Oklahoma, South Carolina and West Virginia.

## **Introduction**

State-funded preschool programs have become increasingly common across the country, having been established to some extent in up to 40 states. While myriad services these programs may provide to families are influenced by complex parental needs which may include longer hours, transportation, health services and the like, the main goal of all state-funded preschool programs is the preparation of young children for the increasingly rigorous challenges of kindergarten. Effective preschool programs lay a foundation for children's subsequent school success by imparting the basics – colors, shapes, numbers, letters, how to look at a book, how to get along with classmates, how to live by the rules in school - sending children to kindergarten with solid successes in preschool and the real confidence that success creates. As the number of state funded preschool programs grow, it is important to determine how effective these programs are in improving children's potential for school success.

### **The MSRP Context**

The MSRP program, targeted to at-risk children, is well-established. The MSRP served 25,712 children in FY '04 using \$85 million in state funding. The state spends approximately \$3,300 per child, serving at-risk 4-year-olds in public schools, Head Start programs and private centers. Operated under the auspices of the Michigan Department of Education, the program requires teachers in public school settings to hold a bachelor's degree. The teacher-child ratio is 1:8 and the maximum number of children is 18 to a class. At least half the children in this program must meet the income eligibility criteria as well as at least one other risk factor from a list of 25 possible factors. A child may also attend if he or she does not meet the income eligibility criteria but exhibits at least two of 25 risk factors.

## **Methods**

### **Study Design**

The MSRP evaluation is based on regression-discontinuity (RD) design, a statistical model with several strengths. The design corrects for one of the most vexing problems in educational research, that of selection bias. Typically, program effects are estimated by comparing the test scores of children who attended a program with the scores of similar children who did not go. Where programs are universal, the problem of finding a "comparable" group of children who did not go to preschool is obvious. Yet, even where programs target only some children, a problem remains: those who go to preschool are *not* the same those who do not. Preschool programs that target specific types of children create these differences, but differences also come about because some parents choose to enroll their children and others do not. In sum, children who go to preschool differ from those who do not because programs select children and families select programs.

The solution is to compare two groups of children who select (and are selected by) the state program, using a fairly stringent age cutoff for enrollment eligibility to define groups. This concept is easier to understand when considered in the extreme case: consider two children who differ only in that one was born the day before the age cutoff and the other the day after. When both are about to turn five years old the slightly younger child will enter the preschool program and the slightly older child will enter kindergarten having already attended the preschool program. If both are tested at that time, the difference in their scores provides an unbiased estimate of the state preschool program's effect. Obviously, if only children with birthdays one day on either side of the age cutoff were included in a study, the sample size would be unreasonably small. However, the approach can be applied to wider age ranges around the cutoff. In fact, all children entering kindergarten from the state preschool program, and all children beginning preschool in the same year can be included using RD statistical techniques that adjust for the effects of age.

The research question of interest is whether attendance in the state-funded preschool program at age 4 has an impact on children's academic skills at kindergarten entry. This question is addressed with identical methods and measures across five states: Michigan, New Jersey, Oklahoma, South Carolina and West Virginia. The programs in Michigan, New Jersey and South Carolina are targeted to at-risk children while the programs in Oklahoma and West Virginia are universal. Each state program is unique, but all required licensed teachers with four-year college degrees and certification in early childhood (with minor exceptions in Michigan).

### **Sampling Strategy**

To choose a sample of children we first randomly selected state-funded preschool classrooms from a list of the total number of state-funded preschool classrooms across the state. We then sampled the same number of kindergarten classrooms as preschool classrooms within the districts from which the preschool classrooms were selected. From each of these classrooms we then randomly selected approximately four children.

Trained research staff from the High/Scope Educational Research Foundation visited each sampled program site, selected children into the sample using a procedure to ensure randomness, and conducted the child assessment as early as possible in the school year. A liaison at each site gathered information on the children's preschool status, usually from existing school records but occasionally from parent report, and was reimbursed \$5 per selected child.

### **Sample**

As mentioned above, the evaluation requires two groups of children. One group currently attending kindergarten who attended the state-funded preschool program the previous year is called the "Preschool" group or the experiment group. The second group currently attending the state-funded preschool program is called the "No Preschool" group, or the control group. This group is called the "No Preschool" group despite the fact that they are currently enrolled in the state-funded preschool program, because they are at the very beginning of their preschool year and have not had the preschool "treatment" yet.

In Michigan, an initial random sample of 144 preschool classrooms across the entire state was drawn, and a matching number of kindergarten classrooms were then randomly selected by district. The initial sample included 71 districts. The Detroit school district required a separate study proposal which was denied; therefore the 40 sample classrooms originally drawn from Detroit were distributed across Michigan's other large urban districts. As a result of district, school or classroom refusals (not including Detroit) data was gathered from 206 classrooms, with an average of four children per class. The total sample size in Michigan is 865 children, 481 in the No Preschool group and 384 in the Preschool group. The sample is 46 percent male, and includes children of different ethnicities in numbers that closely represent the overall state percentages, as follows: White children, 57 percent of the sample; African-American, 25 percent, Hispanic, 12 percent, Asian, 2 percent, American Indian, less than 1 percent; and all other ethnicities, 4 percent.

Findings for the Michigan sample are not directly comparable to findings from the larger study sample of 5071 children including the four additional states because of differences across programs (for instance, children in other states may begin state-funded preschool at age 3) and other circumstances that affect the experiences of children who do not attend state-funded preschool programs. The larger sample is 48 percent male with ethnicities as follows: White children, 47 percent, African-American, 25 percent, Hispanic, 21 percent, Native American, 2.5 percent, Asian, 2 percent; and all other ethnicities, 2 percent.

## **Instrumentation**

### **Receptive Vocabulary**

Children's receptive vocabulary was measured by the Peabody Picture Vocabulary Test, 3<sup>rd</sup> Edition (PPVT-3) (Dunn & Dunn, 1997). The PPVT is commonly used as quick test of IQ and can be used as a rough assessment of general cognitive abilities. The PPVT is a direct measure of vocabulary size and the rank order of item difficulties is highly correlated with the frequency with which words are used in spoken and written language. The test is adaptive (to avoid floor and ceiling problems), establishing a floor below which the child is assumed to know all the answers and a ceiling above which the child is assumed to know none of the answers. Reliability is good as judged by either split-half reliabilities or test-retest reliabilities. The TVIP is appropriate for measuring growth in Spanish vocabulary for bilingual students and for monolingual Spanish speakers. Raw scores are reported.

### **Mathematical Skills**

Children's early mathematical skills were measured with the Woodcock-Johnson Tests of Achievement, 3<sup>rd</sup> Edition (Woodcock, McGrew & Mather, 2001) Subtest 10 Applied Problems. Subtests of the Woodcock-Johnson are reported to have good reliability. Raw scores are reported.

### **Phonological Skills and Print Awareness**

Phonological skills development was measured using the Blending subtest of the Preschool Comprehensive Test of Phonological & Print Processing (Pre-CTOPPP; Lonigan, Wagner, Torgeson & Rashotte, n.p.) The Pre-CTOPPP was designed as a downward extension of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgeson & Rashotte, 1999), which measures phonological sensitivity in elementary school-aged children. Although not yet published, the Pre-CTOPPP has been used with middle-income and low-income samples and includes a Spanish version. Since the Pre-CTOPP has only been very recently developed, very little technical information is available about its performance and psychometric properties.

The Blending subtest includes items that measure whether children can blend initial phonemes onto one-syllable words, initial syllables onto two-syllable words, and ending phonemes onto one-syllable words. The percentage of items the child answered correctly out of the 21 total subtest items is reported.

Print Awareness was measured using the Print Awareness subtest of the Pre-CTOPPP. Items measure whether children recognize individual letters and letter-sound correspondences, and whether they differentiate words in print from pictures and other symbols. The percentage of items answered correctly out of the 36 total subtest items is reported.

## **Results**

The main results of the effects of Michigan's program are displayed in individual figures for each outcome measure. Each figure displays a regression line of the children's predicted test scores by the distance away in days their birth date is from the program enrollment cut-off date. The discontinuity in the regression line at the cut-off date is the estimated effect of the preschool program.

Additionally, results are reported in a set of two tables. Table 1 displays the impact of the preschool program on children's scores. The impact of the preschool program is measured in the same metric as the children's outcome measure, so for example if the measure is in percentage points, the effect is also in percentage points. Table 2 displays average scores and standard deviations for the No Preschool and Preschool groups of children for Michigan's sample. Standard deviations are in parentheses following the averages.

These tables are provided to help interpret the results.

### **Receptive Vocabulary**

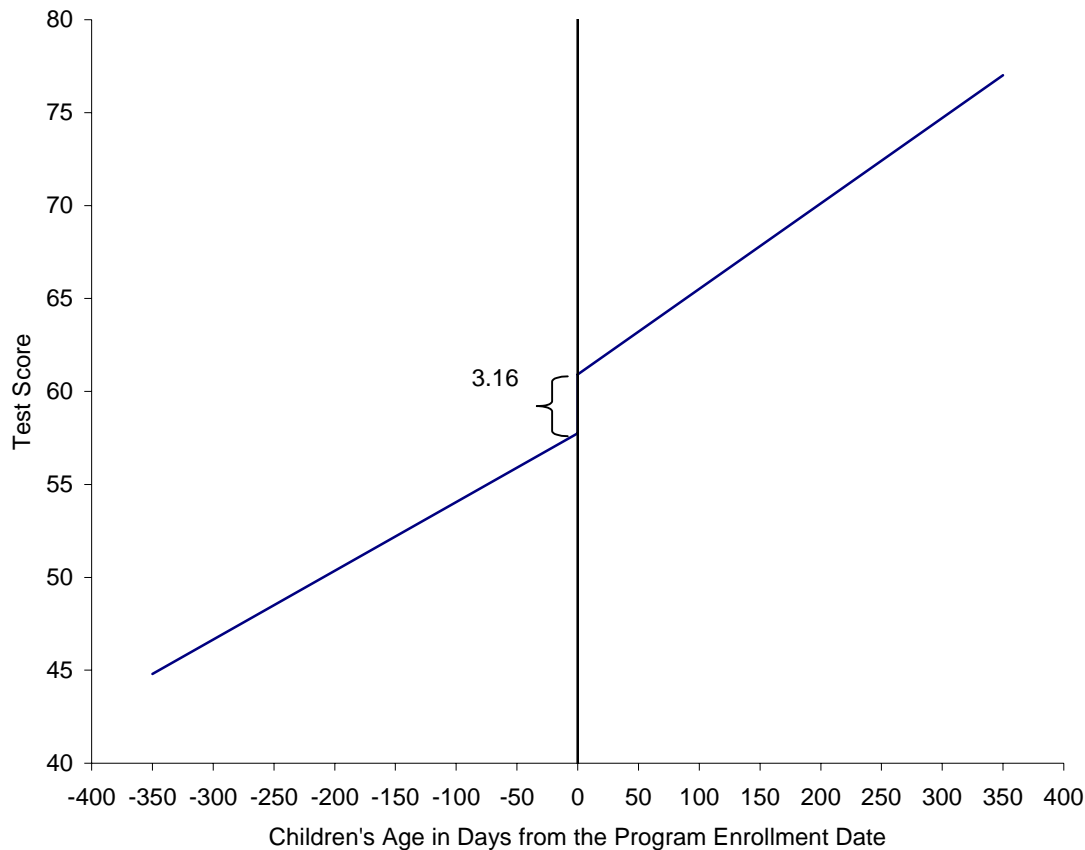
The estimated effect of state-funded preschool on children's receptive vocabulary as measured by the PPVT is statistically significant. Attending the MSRP program at age 4 is estimated to increase PPVT scores by about 3.16 points. For children of preschool and kindergarten age on this measure raw score points translate into about the same number of standard score points, so the improvement is about 21 percent of a normed standard deviation.

The effect of the program can also be understood as 24% more growth over the year or a 6 percent increase in children's average vocabulary scores.

Age equivalence scores provide a measure of children's vocabulary knowledge using a normed estimate of the average age of children who score the same. Results indicate that the average improvement due to MSRP is approximately an additional two months of vocabulary development.

Figure 1 below portrays a regression line of the children's predicted PPVT scores by the distance in days their birth date is from the program enrollment cut-off date. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 3.16 raw score points.

**Figure 1. The Effect of MSRP on Children's Receptive Vocabulary Scores**



### **Math Skills**

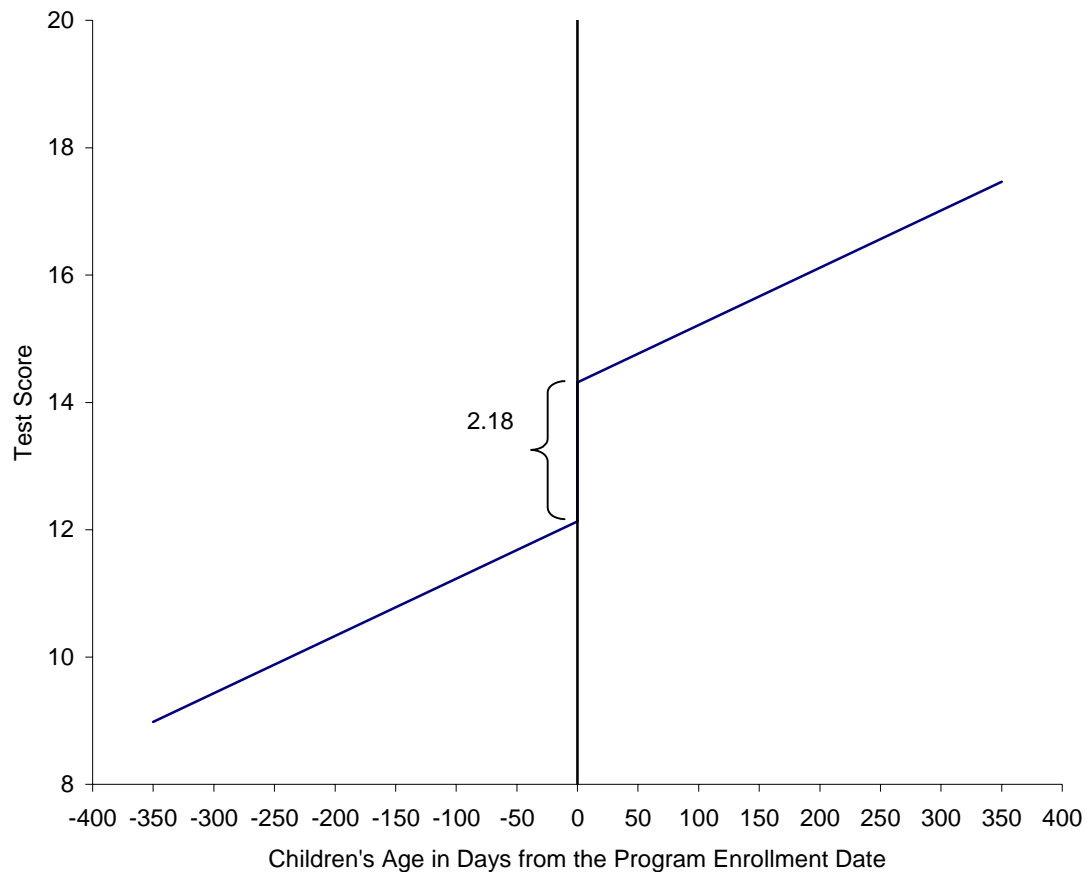
The effect of state-funded preschool on children's early math skills as measured by the Woodcock-Johnson-III Applied Problems subtest scores is statistically significant for MSRP. The increase in scores for children in MSRP due to the program is worth about 2.18 raw score points. One raw score point roughly translates into 3 standard score points for children of preschool and kindergarten age, so the effect of MSRP is equivalent to about 6.5 raw score



points or 44 percent of a normed standard deviation. The effect of the program can also be understood as 64 percent more growth or a 21 percent increase in children's average math scores.

Figure 2 below portrays a regression line of the children's predicted Applied Problems scores by the distance in days their birth date is from the program enrollment cut-off date. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 2.18 raw score points.

**Figure 2. The Effect of MSRP on Children's Early Math Scores**

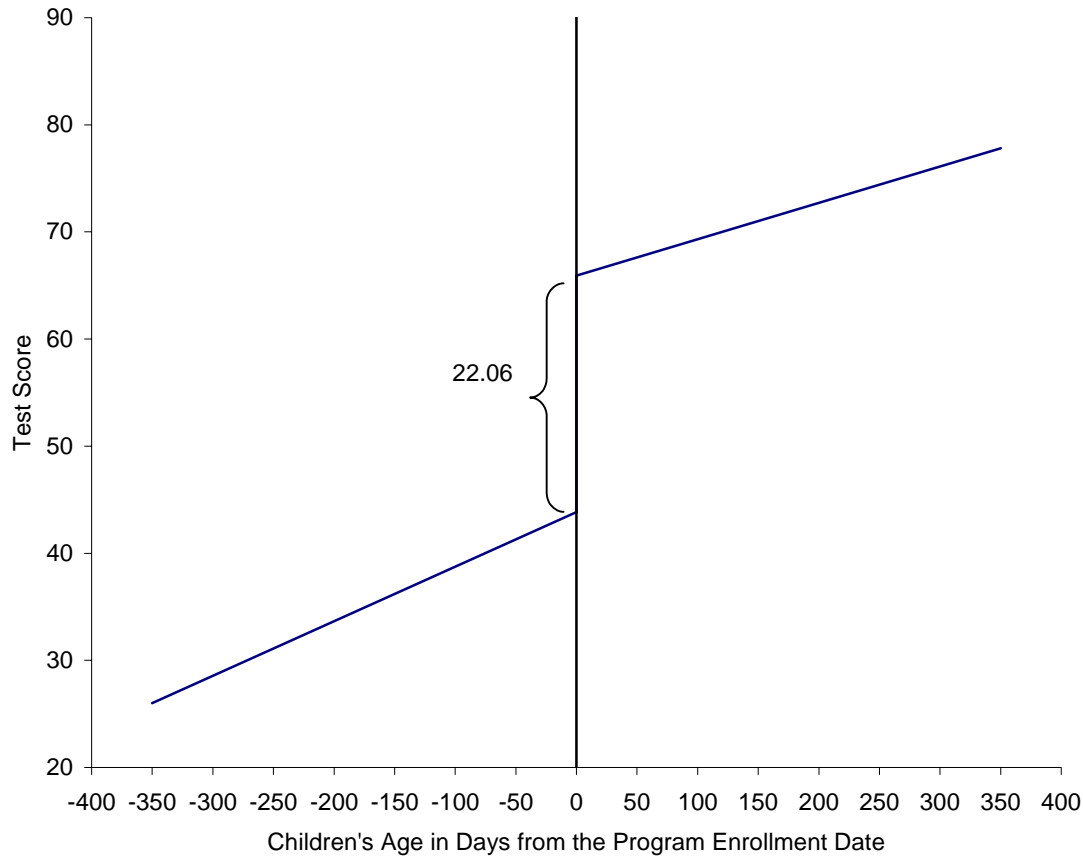


### **Print Awareness**

The effect of state-funded preschool on children's Print Awareness scores is statistically significant for MSRP. The effect of MSRP on children's scores is an increase in the average number of items correct of just over 22 percent. This increase is equivalent to approximately one whole standard deviation on the Print Awareness subtest. The effect of the program can also be understood as 117 percent more growth or a 63 percent increase in children's average print awareness scores.

Figure 3 below portrays a regression line of the children's predicted Print Awareness scores by the distance in days their birth date is from the program enrollment cut-off date. The discontinuity in the regression line at the cut-off date represents the estimated effect of the preschool program, or 22.06 percent more items answered correctly.

**Figure 3. The Effect of MSRP on Children's Print Awareness Scores**



### Phonological Skills

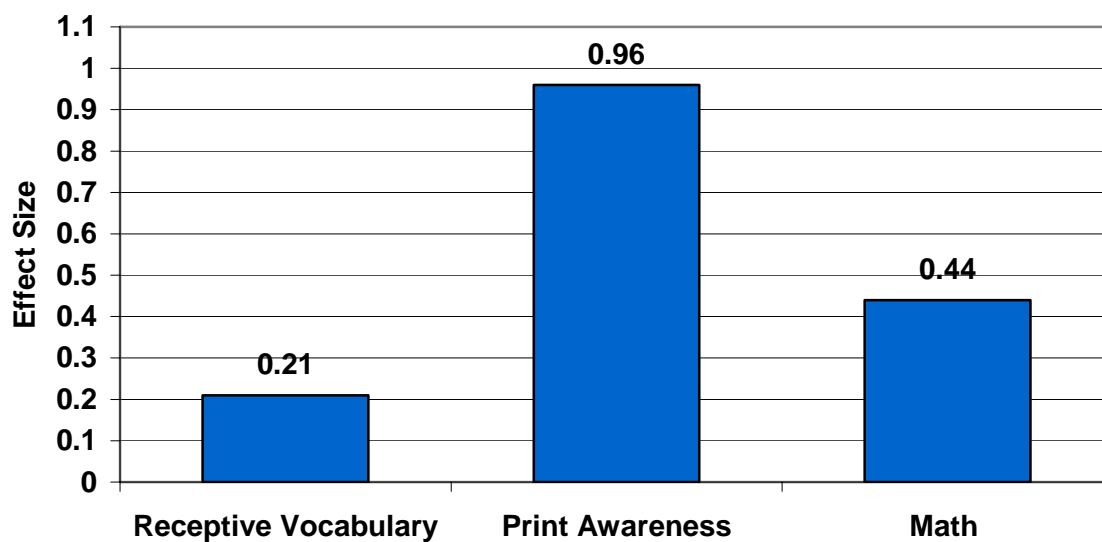
Results indicate that the effect of MSRP and state-funded preschool overall on children's phonological development scores is minimal and not statistically significant. While the difference in Blending subtest scores between the groups may seem large (64.44 percent of items correct for the No Preschool group versus 76.77 percent for the Preschool group), the difference due to the program is not statistically different from zero. The remainder of the difference is most likely accounted for by the fact that the Preschool group children are older than the No

Preschool group children, and they have developed the skills to score higher outside of the preschool program.

### **Summary**

By way of summary, Figure 4 below portrays the effect sizes of the impact of state-funded preschool programs on children's receptive vocabulary, print awareness and math scores. These effect sizes are another way of standardizing the estimated effects of the program so that they may be compared to estimated effects in other studies.

**Figure 4. The Effect of MSRP on Children's Scores across Measures**



### **Preschool Effects and Family Poverty**

Family poverty, measured by free or reduced price lunch status as reported by the school, was not included in the primary analyses presented here because missing data on this measure reduced sample size by nearly 20 percent overall and by more than 50 percent in one state. However, separate analyses provide some evidence for a stronger effect of the program on print awareness skills for children in poverty. This effect approaches significance in the larger study. Overall, children in poverty (ie. those who qualify for free or reduced price lunch) answered about 3 percent more items correctly on the print awareness test than children not in poverty, due to the program, with some states showing a significant effect of about 8 percent more items correct for children in poverty. Otherwise, main results are virtually identical to those presented here when free lunch status is included in the statistical analyses. Michigan's preschool program is targeted to poor children and of the 77% of sample children for whom we have data, 64% receive free or reduced price lunch.

## Discussion

These study findings provide strong evidence of the positive impact of the MSRP program on children's language, literacy and math skills development. This evidence indicates that the Michigan's program produces the kinds of effects that lead to increased school success and later improvements in children's reading and math skills. For example, children's early print awareness and receptive vocabulary skills have been found to predict later reading abilities in the early elementary grades (Snow, Burns, & Griffin, 1998). The effects found in this study are the first link in a chain that produces the long-term school success and economic benefits documented by preschool studies that have followed children into adulthood (Schweinhart, Montie, Ziang, Barnett, Belfield, & Nores, 2005; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Reynolds, Temple, Robertson, & Mann, 2002).

Important positive effects were found for children's receptive vocabulary, math and print awareness skills, with Michigan's program effects on receptive vocabulary scores very similar to the findings of the overall study. Overall, findings suggest that state-funded preschool programs, including MSRP, have largest effects on children's early print awareness skills.

We did not find that state-funded preschool programs significantly improved children's blending skills, our sole measure of phonological awareness. Perhaps these preschool classrooms did not provide as much support for these skills as they did for language development and print awareness (Lamy & Frede, 2005). In that case, activities and interactions to support children's phonological sensitivity – hearing smaller sounds within the spoken word that may be parsed out and switched for others to create rhymes and alternate endings – may need to be increased. However, additional construct measurement issues may influence this finding. The No Preschool sample children produced higher average scores on this measure than the average scores reported by the instrument authors. Higher scores at preschool entry would mitigate the impact of preschool on those scores at kindergarten entry; however, the fact that even highly disadvantaged children had higher average scores while scoring relatively lower on other measures may indicate that this instrument is not measuring those skills well for children of this age. Our results suggest that more research is needed on the measure itself.

This study's results are consistent with findings from other rigorous studies of state preschool education programs (Gormley et al., 2004; Barnett et al., 2004; Frede & Barnett, 1992; Irvine, Horan, Flint, Kukuk, & Hick, 1982). Where direct comparisons can be made, the size of the impacts is quite similar to those found in the recent study of Oklahoma's program in Tulsa. These estimated effects for state-funded prekindergarten programs are smaller than those found for highly intensive model programs that had much better student-teacher ratios and provided more than one-year of education at age 4 (Barnett, 1998), and are larger than those found in the recent national impact study of the federal Head Start program (Puma, Bell, Cook, Heid, Lopez, Zill, et al., 2005).

Using identical or similar tests, the NIEER studies show vocabulary gains two to three times greater than those in the Head Start study. This difference in outcomes between the two types of programs points to the likely effects of the higher qualifications (and higher

compensation) of teachers in state prekindergarten programs compared to Head Start. The state prekindergarten programs we studied do not uniformly differ from Head Start with respect to other characteristics such as length of day or class size.

The states studied almost universally require prekindergarten teachers to be licensed teachers with BA degrees and certification in early childhood education. Head Start requires that 50 percent of teachers have two-year Associates' degrees and the others must have a Child Development Associate (CDA) credential or its equivalent. A CDA represents 120 hours of training. Comparisons to Head Start suggest that public preschool programs with weak standards for teacher qualifications (and low teacher pay) might increase their effectiveness by raising their teacher qualifications standards and compensating teachers accordingly.

In sum, this study finds that the Michigan School Readiness Program produces significant, meaningful improvements in children's early language, literacy and math skills development at entry into kindergarten, similar to the results of other relatively high-quality programs across the country.

**Table 1. Comparison of the Effects of State-funded Preschool Programs across 5 States and of MSRP on Entering Kindergartner's Academic Skills**

	PPVT	Blending	Print Awareness	Applied Problems
Sample size	N=865	N=839	N=853	N=866
MSRP effects	<b>3.16 raw score points</b>	1.83% correct	<b>22.06% correct</b>	<b>2.18 raw score points</b>

Note: Findings that are statistically significant at  $p \leq .05$  are bolded.

**Table 2. Group Averages and Standard Deviations for Preschool and No Preschool Groups**

PPVT raw scores		PPVT standard scores		Blending percent correct		Print Awareness percent correct		Applied Problems raw scores		Applied Problems standard scores	
No prek	Prek	No prek	Prek	No prek	Prek	No prek	Prek	No prek	Prek	No prek	Prek
51.37 (16.98)	67.75 (17.20)	95.39 (14.30)	96.66 (13.59)	64.44 (27.05)	76.77 (25.12)	35.14 (23.06)	76.10 (21.71)	10.54 (3.91)	16.11 (3.95)	98.18 (16.51)	100.06 (12.06)

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